Homework 8 Solutions

May 28, 2004

1 Problem

1.1 Part a)

The Hubble constant relates the distance a galaxy (or any other object sufficiently far away from us, so that the gravitational field of our galaxy doesn't affect it) is away from us to the recesional velocity that galaxy has. Therefore the slope in the graph is the Hubble constant. Taking the (x,y) coordiantes of the first point and the origin, we get fro the slope:

$$H = \frac{75 - 0}{1 - 0} = 75\frac{km}{sMpc} \tag{1}$$

1.2 Parts b) and c)

Now if we transform the Hubble constant to seconds using that $1Mpc = 3.085 \times 10^{19}$ km, we get:

$$H = 75\frac{km}{sMpc} = 75\frac{km}{s} \times \frac{1}{3.085 \times 10^{19} km} = 2.43 \times 10^{-18}\frac{1}{s} \tag{2}$$

Assuming that the universe expanded at constant rate, and noticing that the graph is a linear relation between speed and distance($v = d/t$), we realize that taking the inverse of H will give us an estimate of the age of the universe $t_{universe} = 1/H = 4.113 \times 10^{17} s = 1.3 \times 10^{10} yrs$.

1.3 Parts d)

Doing the same calculation for Hubble's Hubble constant we get $t_{universe} = 1.95 \times 10^9$ yrs. This age was a problem because there exist objects in our own galaxy known as globular clusters of stars whose ages are bigger than this value. Therefore the universe posses objects in it that are older than the universe itself; a clear absurd.